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## Competitive Advantages of Financial Transactions on the Basis of the Blockchain Technology in Digital Economy

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N.G. Vovchenko<sup>1</sup>, A.V. Andreeva<sup>2</sup>, A.S. Orobinskiy<sup>3</sup>, Y.M. Filippov<sup>4</sup>

**Abstract:**

*Modern economy is developing in a process able format, gradually turning into a virtual economic system. Digital economy serves as the new paradigm of economic development and reformats business relationship on the basis of the use of information.*

*New information and network technologies are becoming major factors of globalizing economy production and contribute to rapid transition of economic agents from real sector to a network one, ensuring digital economy development and innovative business processes formation.*

*The blockchain technology implements competitive advantages of financial contracts based on reduction of the costs on economic agents' interaction, provision of information transparency and effective control over operational risks. The blockchain technology contributes to financial security of the modernization operations of business processes and high organized centralized structures of the blockchain technology.*

*The blockchain application for financial transactions allows providing high quality of the contracts implementation between the digital economy's economic agents.*

**Keywords:** *additive technologies, blockchain, business processes, sensors, network, financial transactions, commercial banks, competitive advantages, costs management.*

**JEL Classification Codes:** *G10, G32, M1, M4.*

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<sup>1</sup> Vovchenko Natalya Gennadyevna, D.Sc., Professor, Department of Finance, Rostov State University of Economics, Rostov-on-Don, Russian Federation, corresponding author [nat.vovchenko@gmail.com](mailto:nat.vovchenko@gmail.com)

<sup>2</sup> Andreeva Alina Vladimirovna, Ph.D, Associate Professor, Department of Economics and Finance, Rostov State Transport University, Rostov-on-Don, Russian Federation.

<sup>3</sup> Orobinskiy Andrey Sergeevich, Deputy Finance Director of LLC "Agrotekh-Garant", Ph.D., Associate Professor, Department of Taxes and Taxation, Voronezh State Agrarian University, Voronezh, Russian Federation.

<sup>4</sup> Filippov Yuri Maksimovich, Postgraduate, Rostov State University of Economics, Rostov-on-Don, Russian Federation.

## **1. Introduction**

Institutional reforms in labor relations are carried out in digital economy both in the content and in the form. New technologies restructure subject-object economic relations and change qualitatively a business model based on special algorithms application. Specific nature of reforms in labor and economic relations is reflected in the fact that the processes of production, distribution, exchange and use of information are becoming crucial with regard to other types of business and economic activities, besides they are influencing them. Digital economy has also led to a change of the production technological base, when the Internet in terms of neo-economy transformations has turned to be a dominant factor in ensuring modern business development. Besides it has started fulfilling the functions of a mega institute, ensuring the structured data transfer via the network. Quantum technologies and biotechnologies, which have formed two parallel developing trends of modern science, are aimed at integration with a purpose of creating new virtual reality.

For the risk immediate detection and regulation not only technological innovations should be developed, but also the economy institutional structure should be improved. Sustainability of e-business and digital economy systems development depends on the quality of the business environment and institutions forming the factors of economic development. Formation of the digital economy developed infrastructure is directly related with ensuring the economic agents' information and economic security.

Currently financial and technological startups compete successfully with financial companies and firms of various formats from different economy sectors in business processes quality, information adaptability, financial transparency and speed of operations. At the same time innovative financial companies implementing competitive advantages through information and network services are also able to influence negatively on the functioning of the companies from traditional industries.

## **2. Theoretical, informational and empirical, and methodological grounds of the research**

The concept of “digital economy”, associated with information and network technologies development (the author of the definition is Nicholas Negroponte), appeared in 1995 (Negroponte, 1995). Digital economy is a kind of activity in which the key production factors are the data presented in digital form, as well as the provision of information and communication services. Digital economy as an economic category is associated with the beginning of the process of all-over informatization of the second generation. Information and network technologies themselves served as the basis for the emerging VI technological mode. In fact all sectors of economy and society in terms of digital economy have undergone fundamental changes. There appeared intelligent systems, biotechnologies,

blockchain technology, ensuring neo-economy development. Currently the experts consider the blockchain technology application as a promising platform for business development, first of all in high technology and investment and finance area (Osipov and Zotova, 2015).

New tools are necessary to implement a model of digital economy. Such tools, for example, can be modern sensors having characteristics of energy efficiency, accuracy, as well as rather small sizes and low manufacturing cost. Currently the Russian Federation Government is actively developing a strategy for the digital economy formation, as all branches of the Russian economic complex have begun the process of digitalization. The strategy of the information society creation, which was approved in 2008, could not foresee such global changes in the information and network business development model. The purposes of digital economy formation strategy are related with ensuring the country's technological sovereignty. In May 2017 the program "Digital Economy" has to be developed considering the plans of the Eurasian Economic Union (EAEU) development. The Russian Federation President Vladimir Putin in late December 2016 at the Supreme Eurasian Economic Council meeting determined the formation of single digital space of the Eurasian Economic Union and expansion of economic relations digitalization as high-priority tasks.

At the beginning of 2016 the Board of Eurasian Economic Commission (EEC) approved the creation of single digital space concept development in the EAEU, and at the end of the year ECE signed an agreement with the World Bank to conduct joint scientific research of potential economic effect. In December the work of analytical groups was organized at the analytical center of the Russian Federation Government, and later at the World Bank's Moscow office. These groups had been posed the tasks of definition of the digital economy and the principles of digital development in Russia. They were created as a part of the World Bank's initiative implementation on the preparation of the report "Digital Economy: Perspectives for Russia" at the international congress "Smart Russia 2016". In late 2016 the information on the beginning of the discussion of the draft of "Strategy of Information Society Development in the Russian Federation" new edition appeared on the Russian Federation Security Council website. This includes directions of digital economy development up to 2030 as new economic development paradigm.

### **3. Results**

Innovative network technologies create hyper-communications rapidly. The Internet technologies have evolved from scientific cooperation to the distributed commands functioning in all spheres. Information and network technologies provide system effect of full presence. Of course new business communications development causes changes in business processes and institutional conditions determining the joint activity formats. In the digital economy the engineer's individual talent is the main condition for a successful project implementation, but at the same time the carrier of

talent and knowledge should have developed abilities to communicate and work in a distributed network environment. Ideas for business in terms of public information appear in different research groups.

In the industrial economy the innovation managers appeared only in high-tech companies; and in digital economy the specialists having such competencies appeared in large state-owned companies, commercial banks, construction corporations. In digital economy the innovation can be divided into several types: innovation in processes, innovation in services, innovation in products and strategic innovation.

The blockchain technology use based on the contracts' information transparency provides the financial and technology companies with competitive power, as well as reduces the costs of economic agents' contracting, allows managing the companies' operational risks and controlling costs on the network and financial transactions. The blockchain technology competitive advantages are not only the ability to expand the tools of operations, but also the new deals formation. Institutional management of innovative contracts is ensured by program codes and miners on the basis of blockchain apps.

#### **4. Discussion**

Digital economy contributes to effective business modernization, but at the same time it has negative effects associated with personnel reductions as a result of general business processes automation. Financial and credit and insurance institutions are currently suffering these risks. Introduction of remote banking systems leads to job cuts, federal chains narrowing, offices shutdown, partial dismissal of experienced operational personnel and reduction of offices. The introduction of information and communication technologies of the digital economy changes the commercial banks business processes. For example, banking systems of risk management are developing, tools of borrowers' creditworthiness assessment based on the use of big data are improving, and risk assessment scoring systems are being upgraded in the new format of business processes automation. A comprehensive analysis of the borrowers' economic activity allows predicting possible credit risks and determining more accurately the borrowers' creditworthiness on the basis of information and network tools.

The experts of a consulting company "Spencer Stuart" conducted a test of the readiness of Russian companies undergoing a stage of business and production modernization to use digital technologies. They surveyed CEOs of more than twenty companies in the top 100 largest companies by capitalization of the Russian Federation enterprises. The majority of respondents believe that digital technologies will form perspective and sustainable factors of the company's growth. According to another research by Grant Thornton of 2,000 businessmen from 36 countries, one in

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four considers the expertise in the digital technologies sphere as the most important source of growth in the next 10 years (Gorelova, 2016).

A significant part of the companies' heads has started applying the new information and communication technologies in the system of companies' management, but they do not have a ready model of their application. When introducing new technologies, the main problems are the employees not willing changes, as well as shortage of personnel having digital competencies, respondents believe. Seven surveyed CEOs admitted that new technologies would require radical changes in their companies. According to the Spencer Stuart survey, most of all digital technologies influence the business processes in the sphere of human resources management (39% of respondents), relations with customers (20%), sales (16%), operations management (13%), logistics and procurement (12%). Heads of the companies in consumer sector (food production, retail, services), media business (printed mass media, radio, TV), as well as travel agencies informed about possible risks (Gorelova, 2016).

Thus, according to the companies' heads, digital economy will create new conditions for business development. At the same time some participants of the Spencer Stuart survey in Russia believe that the dominance of digital technologies development can serve as a risk for the business established on the basis of traditional business models. For example, development of online shopping has led to the bankruptcy of retail book chains in Europe. Competitive companies are reformatted and start operating as new services. For example, the "Amazon" company was a book retailer at the beginning, and now it is the largest supplier of cloud technologies.

The global financial and credit services market is highly competitive. So with the purpose of successful competitive positioning the commercial banks tend to apply high technologies in management system, including information and network technologies, which a blockchain technology belongs to. Innovative network systems based on the distributed registers, as a result of their work create risks that need regular control system. In terms of the increased global economy uncertainty both financial regulators and market operators must constantly monitor these risks occurrence. Cyberattacks are difficult for risk regulation in financial companies and credit institutions working with virtual money. In late 2016 such risks were recorded in information and financial systems of the DAO and Bitfinex trading platforms. As a result of cyberattacks more than \$50 million was withdrawn from the financial system of the DAO company owning the Ethereum platform, which trades the "ether" currency. As a result of a hacker attack the Hong Kong financial company Bitfinex which trades bitcoins lost \$65 million (The Industries Threatened by New Technologies, Vedomosti, 2016).

Today information and network technologies serve as the basis for ensuring the companies' information and economic security. Russian scientists analyze in detail modern trends of digital economy having direct impact on the innovative

companies' formation both in financial and non-financial sector of the global economic system. The use of digital technologies provides sustainable competitive advantages for the business development in terms of economy virtualization (Yudina, 2016).

Experience of the USA and the European Union on the institutional design of innovative business environment is the basis for the successful development of digital economy based on network interactions and information technologies (Hanna, 2010; Gorelova, 2016; Vovchenko *et al.*, 2017a; 2017b).

Solution of the challenges of creating the European Union single digital market, oriented to leveling the competitive position in the field of high technologies in comparison with the USA and China, was aimed at effective development of regional informational mega system. The regulators of this problem in the European Union have developed the Digital Single Market Strategy (DSM) on the basis of the use of strategic competitive advantages associated with a well-functioning system of interaction between agents of single European digital market (Digital Economy and Society Statistics, 2015).

This concept is oriented to coordination of the conditions of running digital business and overcoming institutional constraints for the innovative economy development. The concept includes the tools of adjustment legislative conditions of European countries for the digital economy development, methods of new jobs creation in the companies of innovative type, programs of training the specialists having necessary competencies to work in such companies, as well as measuring tools of risk assessment. Implementation of Digital Single Market Strategy (DSM) concept is aimed at ensuring the economic development effectiveness. For example, the strategy should contribute to the European Union countries' GDP growth by about 40% by 2020, as well as qualitative transformation of the labor market and expansion of information and network communications to accelerate the digital economy development. An increase in the number of jobs in the European Union countries from 1.6 to 2.3 million is expected until 2020 (Digital Economy and Society Statistics, 2015; The Industries Threatened by New Technologies, Vedomosti, 2016).

In accordance with the concept developed by the European Commission the basis of the European Union Digital Single Market Strategy consists of the following activity areas: provision of the access to digital goods and services for consumers and enterprises throughout Europe; creation of favorable conditions for the development of digital networks and creation of innovative services; increasing the European Union digital economy potential.

Digital Single Market Strategy concept is targeted to achieve the following objectives:

- Simplification of online shopping rules for consumers;

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- Ensuring equal access to online content and services regardless of the location in the European Union;
  - Stimulation of the development of digital competencies and education related to the digital transformation;
  - Provision of more opportunities for the innovative companies creation;
  - Improving efficiency in making decisions of the union level concerning data protection policy;
  - Stimulation of the telecommunication industry reform;
  - Change, facilitation and increase in transparency of legal and regulatory bases of intellectual property considering new technologies.

A special feature of the digital economy concept is the use of information and network technologies and innovative methods of e-business in financial sector, government control sector, education system and a number of other spheres. Members of the European Commission rely in their work on the use of South-East Asian countries best practices in the economic system digitalization process development on the basis of the design of information exchange general system on a number of activities with other countries, e.g. Russia, Norway, Switzerland and other countries.

In the meantime different views on the formats of institutional design of such information system of the European Union countries create various restrictions for its formation and development. For example, the Digital Single Market Strategy does not have a coordinated logistic structure, which complicates the structuring business processes of the institutional design. The strategy does not have the highlighted priorities for the digital market formation, which increases the period of the project implementation in connection with the process of multilateral coordination. The European Union member countries' produced proposals concerning development of regulatory basis and mechanisms to regulate the digital market differ significantly from each other, which involves the creation of a single project plan.

A detailed expert analysis of the European Union member countries' readiness for the digital market creation has revealed a number of limiting factors preventing the digital economy formation. Such factors include the following:

- Significant differences in legislative regulations and economic policy of the European Union member countries (in particular, the rules relating to value added tax, personal data protection, requirements to the product operational safety and the provided services standards) (Bauer and Erixon, 2016; The Industries Threatened by New Technologies, Vedomosti, 2017).
- High costs on new markets entry (organizational costs, resource costs);
- Technological barriers existing in a number of countries.

The strategy of the digital economy institutional design and the European Union single digital market formation determine the need to develop coordinated methods of taking measures at the national level. The countries having a high level of digital economy development as well as innovative companies operating in the most developed countries in terms of information and communication are urged to play an important role in this area. These countries include: Sweden, Denmark, Finland, Belgium, Luxembourg, the Netherlands, Ireland, Estonia, and Norway. In terms of new conceptual approaches development the information projects should form directions of the digital economy development and the tools of their implementation on the basis of all-over business digitalization for the single market creation.

If we turn to the experience of creating digital control systems of large corporations, it is necessary to highlight the IBM Company, designing successfully an innovative system based on the blockchain technology. The technology involves a complete verification of the participants. This contributes to reducing risks of the system functioning, as it provides transparency of mechanisms and technologies. High protection of transactions that are carried out by applying blockchain technology is ensured by the fact that they cannot be cancelled at any level. That's why the blockchain technology is attractive for commercial banks and large corporations of the globalizing world economy. An important advantage of the blockchain technology application is low operating costs. The strategic need to reduce costs, which is actual problem of almost all modern financial institutions using information and network technologies, increases the importance of the tasks of introducing technologies of this format.

Currently the rapidly developing technological start-ups and companies operating on the principle of "sharing economy" provoke competition to many economy sectors. It is important to note the negative impact of technological start-ups on the functioning of the companies of traditional industries. For example, the Uber company and other information and network services have restructured the market of private carriage of passengers; and the Airbnb, the service of houses rent in travels, has provoked competition to hotel industry.

The Financial Times experts conducted a marketing research of the information and network communications market and identified areas of business, which may disappear or reduce greatly in size in terms of digital economy.

Despite the fact that new technologies create great risks for the development of travel companies, travel agencies are continuing to develop actively their business, but in a new format. In terms of competition with high-tech operators in the market only the companies using innovative approaches to business development will remain out of tour companies. The most competitive companies can afford specialized service programs organized for their customers on a particular occasion. For example, this occasion can be special trips on customers' request associated with the celebration of events important for clients. Most of the innovation-oriented travel

companies use information systems to establish close communication relations with customers as part of marketing interaction.

The result of the travel companies' business model change will be the key business processes restructuring. Today travel agencies tend to use digital technologies in the system of marketing management of information flows. Close ties with customers provide tour operators and travel agents with greater economic independence. Consequently travel agencies have a reduced dependence of the business profitability from the sale of package tours, but increase the role of quality management associated with the ownership and management of hotels and cruise ships. In this case the electronic communication with customers is formed and the remote service programs are developed. For example, the Tui travel company which is a global tour operator owns a chain of travel agencies under the brands of Thomson and First Choice. According to the companies' management assessment, the contribution of hotels and cruises to ensuring the business profitability is about 35%, and the expected level of these factors influence on the company's profits with the use of digital technologies of communication with clients will be more than 50% (The Industries Threatened by New Technologies, Vedomosti, 2017).

The Tui company's new business model reflects general trends that emerged in the American travel market in connection with the digital economy development. The number of stationary travel agencies receiving their clients in traditional offices has been reducing for several years already. This is due to the fact that it is easier for modern tourists to form themselves their own travel programs with help of network technologies, using the technology of information interaction through online platforms such as Expedia. According to the Bureau of Labor Statistics USA the number of travel agencies in the country decreased from 132 thousand in 1990 to 74 thousand in 2014. The Bureau predicts that by 2024 the number of travel agencies will decrease by 12% (The Industries Threatened by New Technologies, Vedomosti, 2017).

In order to reduce costs the British travel company Thomas Cook passed to the e-business format by closing traditional offices because of low profitability. Changing the business model the company Thomas Cook promotes its products with help of digital technologies. With the purpose to ensure liquidity of its products the company manages costs effectively. At the same time it strives to use its own hotels and aircraft park. Analytical study of the Association of British Travel Agents has shown that the vast majority of travelers make reservations online. Meanwhile the number of customers buying travel products in traditional offices does not reduce. But the qualitative difference of such customers is a high level of solvency. The data of the Association of British Travel Agents indicate that the most-affluent clients go to the tour operators. Among this group 35% make travel reservations through the agencies.

Global changes in information technologies, e.g. 3D printers' development reformat the logistic chains of supplies. 3D printing will bring qualitative changes in the business organization of corporations in different industries. Due to digital technologies development the innovative companies got the opportunity to print the majority of the necessary components, rather than ordering them from suppliers. The Siemens Corporation is one of the first industrial companies in the world that started using 3D printing technology in the daily manufacture of metal products. Meanwhile a number of major industrial companies from EADS to General Electric are also preparing for this technology introduction in the production. The Bosch Rexroth Company, a division of the German Bosch Corporation on the production of gears and control systems, predicts that in the near future it will be possible to produce up to 40% of the used production equipment on the basis of 3D printers. 3D printing technology application is changing the business model of the companies in production and services spheres.

On the basis of new technologies it is possible to open the production of spare parts for old cars or engines, prototypes of new products or small lots of industrial products. Competitive advantages of new technologies are determined by the difference in cost of the printed components of the equipment and the ones produced in traditional way, which is 50-60%. 3D printing technology is able to fully automate all processes in the majority of building companies in the global economy. Let us consider the history of this innovative technology creation. In 1995 American scientist Behrokh Khoshnevis patented the 3D printing technology from the materials made on the basis of ceramic polymers. A technology for creating printers that print parts of the buildings from traditional materials based on cement was tested in the 2000's in the UK. In early 2014 the 3D printing technologies started to be used in the construction of houses made of concrete. For example Chinese WinSun has printed 10 buildings using this unique technology; currently it has even a five-storied house. Now the companies ZhuoDa group and HuaShang Tengda apply these technologies in China.

Information and network technologies ensure the implementation of complex architectural objects with minimum investment. Innovative printers can produce facilities of any shape for fixed costs. Currently in the building industry a unique technology is developed for the implementation of each unique project. Now the building 3D printers are in the early stage of development. The 3D printing technologies are just entering the market and are not very common in the construction industry, as they have a low efficiency, e.g. up to 1 cubic meter per hour. According to the expert information it is possible to print 100 sq. m. of the house for 100 hours (Perevoshchikova, 2016).

The 3D printers' development will provide new opportunities to create unique projects: the embodiment of brilliant ideas will not require huge investments. Portal type printers are used in the building industry; in their basis there are the guiding rails, on which a construction with a head moves. According to the G-code

transmitted to the printer this construction prints from concrete mixtures layer by layer the articles of any form from benches and sculptures to partitions and walls of buildings, in correspondence with a project drawn in any drawing program. The technology resembles the monolithic construction, but has the advantages of high speed and printing accuracy. The 3D printers use provides opportunity to design elements of any shape. This technology does not differ much from panel construction. In the building industry 3D printers can be used to create the elements of the buildings in the factory environment. It is not convenient to apply these technologies directly on site because of limited sizes.

In spite of a number of limitations the printing of houses right on the foundation is already happening. Recently on the territory of Ekaterinburg cement plant a two-storied building in the form of a tower of the Winterfell castle from the "Game of Thrones" series was built in such a way (25 sq. m., height 5.5 m.). The most promising area of portal type 3D printers' application in construction is the creation of unique, complex parts of buildings with minimal effort in a short time. Consequently portal type 3D printers can be integrated into modern construction technologies, as well as ensure their modernization.

The Russian company Apis Cor developed a mobile 3D printer and in early December 2016 presented a printed one-storied house with an area of 36.8 sq. m. in the territory of Stupinsky Cellular Concrete Plant in vicinities of Moscow. The printer scans the surface and starts printing: permanent formwork for the foundation, self-bearing walls and partitions. So even high rise buildings can be built this way. According to A. Chen-yun-tai, the Apis Cor project manager, the created construction differs from the principle of the portal type devices operation. The 3D printer represents a peculiar tower crane, which prints the building from inside. Innovative construction has a small size, when folded 4 m. long and 1.5 m. high, weight 1.5 tons. The printer's installation on site takes only about an hour, describes Chen-yun-tai (Perevoshchikova, 2016).

Currently the technologies of 3D printers use have limited spread in construction; they are only being tested even in developed countries. The 3D printers are used rather optionally to create interiors in an office space, for example, to form various functional areas. In future the 3D printers will be used to build up private residential houses, garages, summer houses; to manufacture different internal forms and decorative elements, as well as to create separate building components and for assembly on sites of any size. Thanks to low cost and high speed of construction the small buildings printed on the 3D printers can become rather popular for solving social and economic tasks of depressed Russian regions development.

The 3D printing technology is interpreted as additive. This technology provides lower costs of production. Unlike traditional technologies 3D printing allows modeling the object on a computer and producing it from plastic, metal or composite

materials. With help of 3D printing technology the companies of innovative type provide the growth of labor efficiency and become more competitive.

The institutional conditions for ensuring the full transition to new technologies in construction, in particular – creation of bearing walls and other bearing structures using 3D printing, determine the need to approve the relevant regulations. For example, currently in Russia the construction of all buildings with an area exceeding 1,000 sq. m. and a height of 12 m. (three floors) is subject to state expertise, which assesses the projects in accordance with existing laws and regulations. It is necessary to amend the Technical Regulations on Safety of Buildings and Facilities (384-FZ) and the Technical Regulations for Fire Safety Requirements (123-FZ) for the full 3D printers' application. It will also require appropriate changes in the Town Planning Code of the Russian Federation. The changes will touch also the system of technical standard documents included in the list of national standards and sets of rules. Institutional regulating rules of the 3D printers use in construction are developed in the UAE. In this country a one-storey office building Dubai Future Foundation with area of 250 sq. m. and a height of 6 m. was built with help of a Chinese 3D printer. Experts believe that in 8-10 years 3D printers will be massively used for the construction of private residential houses, and in 10-20 years almost any buildings including high rise will be erected with help of new technologies. Such technologies will replace the typical house building, which is more expensive (Perevoshchikova, 2016).

The UC Rusal Corporation has signed an agreement of intent with the DMG MORI concern and is going to develop the 3D printing technology with the use of aluminum powders and alloys. The corporation is going to be certified in order to carry out the supply of the produced aluminum powder to DMG MORI itself and its customers. The powder for 3D printing represents spherical particles from aluminum alloy with additives of 20 to 100 microns in diameter, the technologists believe. In the process of 3D printing in the technology used by DMG MORI, the powder particles are ejected by inert gas under pressure from the printing head and at the same moment they are sintered by the laser. As a result of this innovative technology application it is possible to create a detail of any difficulty. In its turn the DMG MORI company based on the marketing promotion will recommend the UC Rusal as a certified supplier of powders when buying a printer. This is the first contract for the supply of aluminum powders for the 3D printers in the history of the UC Rusal. Due to high production self-cost the 3D printing is expensive. Prices vary from \$ 10,000 to \$ 200,000 per ton. In terms of consumption of raw materials for printing the world market is only being formed. So now the UC Rusal Corporation has a perspective position to enter this market. In modern conditions the world market of aluminum powders for 3D printing is only 150 tons per year; and 500-700 tons per year of other alloys powders. The UC Rusal Corporation is able to produce annually up to 20,000 tons of aluminum powders of various brands, including any volume of powders for 3D printing required by the market. In the mid-run the UC Rusal

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Corporation intends to take 25% of the world market of powders for 3D printers (Petlevoy, 2016).

An integration of complex business processes is happening as a consequence of the information and network technologies development. The accumulation of complex processes in the economic activity increases due to the rise of information density and data transfer speed and automation. Information and network technologies ensure the network and hybrid structures development. Despite the digital economy expansion the traditional hierarchical systems' (first of all states and corporations) speed of reaction to external changes cannot grow fast. A fragmentation of economy and reduction of the production efficient size in many industries are happening at the moment. An example is the 3D printing technology and the product system individualization. Application of new technologies is replacing traditional professions and reducing jobs. For example, today the Uber developing technology eliminates the taxi operators faster than the computers abolished typing bureaus at its time.

Currently Russia takes the 43rd line in the world rating Global Innovation Index – 2016 (GII) and is far behind the world leaders in this area, such as Switzerland, Great Britain, Sweden, and Finland. Business leaders demonstrate low innovation activity, losing competitive position. Today in Russia there is the state demand for innovative products; research and development spending and research cooperation increased in the budget sector. In 2016 the results of the innovative development programs (IDP) entered into the top managers' KPI of almost all state corporations. For the oil and gas sector companies the share of key performance indicator of innovations as part of KPI must be at least 10%; it should be 20-25 % for all other companies.

For example, the “Rostec” State Corporation top managers' 35 performance indicators are related to the implementation of innovative programs, mainly these are the research and development projects and technical modernization. By 2020 the corporation has to develop 570 industrial basic and critical technologies. It should be also noted that for the first time the Vnesheconombank (VEB) included in its strategy the investment of innovative technologies, such as neurotechnologies and blockchain.

The division of innovations was created in the PJSC “Sberbank of Russia” in 2013; and in early 2016 this structure was transformed into a Center of Technological Innovations. This center has a team of project managers and a group of engineers and programmers who develop the bank's pilot projects. In 2016 the center developed 16 pilot projects. The projects on the development of voice biometrics, corporate messenger, and employees' work schedule management systems have already been implemented. The Sberbank, for example, uses quantitative and qualitative KPI. The quantitative indicators reflect the share of the used in commercial operation and disseminated pilot projects and prototypes in a total

number of completed tasks. Meanwhile the qualitative indicators are related to the index of internal recommendations. This index indicates the willingness to recommend the team to implement innovative tasks in other divisions.

New types of business which develop rather effectively on the basis of low costs appeared in the digital economy. For example, the WhatsApp Company, being a small company and not having outstanding intellectual property, was acquired for \$19 billion. The digital economy technologies development contributed to the fact that the specialists having a high level of knowledge and competencies started moving from one territory to another choosing the more favorable conditions for work and rest. The power of information and network communications is not in the number of hierarchical levels but in a variety of economic agents, density of connections and ability of the human capital to accumulate knowledge. A high level of education, experience and competencies distinguishes the profession of financial advisor, which suffers pressure from innovative technologies in terms of digital economy. Banks and managers of wealthy clients' assets and property have already assessed the potential of automated consulting of retail customers and rushed into this sector, where fast-growing financial and technology companies dominated recently. The British financial corporations Barclays, Royal Bank of Scotland, Lloyds Banking Group and Santander UK have started developing online platforms for investment.

In the post-crisis period the traditional financial advisors had to face with a serious tightening of regulation. In 2013 new rules of the UK Financial Conduct Authority (FCA) changed dramatically the business model of financial consulting: the funds were prohibited to pay commissions to consultants and the minimum qualification requirements for the latter were raised. According to the calculations of the British Association of Financial Advisors 13,500 people left the profession after the new rules introduction. A huge number of investors who suddenly lost the opportunity to afford a consultant turned to a new phenomenon: the robots-consultants appeared in 2012. In 2015 in the course of research the FCA found out that two thirds of individual investors buy financial products without asking professionals for advice.

A highly experienced specialist revealing the customer's economic behavior peculiarities works in the traditional market as a financial advisor. In the digital economy these functions are implemented by an information system capable to process large volume of data in a short time. The robots-consultants are the online platforms selecting an effective investment portfolio based on the user's answers to the questions of the on-line questionnaire. They offer to the clients, who are convenient to invest online, a cheap alternative to a personal contact with a consultant. According to the Citigroup analysts, in the next decade the amount of assets managed by robots could reach \$5 trillion all over the world (Kucher, 2017).

In digital economy other major financial market participants prefer buying startups. The Schroders management company bought a share in the Nutmeg, a developer of

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the robot-consultant, for £12 million; and Allianz Global Investors bought a share in the MoneyFarm. In the USA the automated services manage portfolios of shares of Exchange Traded Funds (ETF), reinvest dividends and optimize the taxation of income from investment.

The Betterment service, receiving commission income of 0.15-0.35%, currently manages the assets of 210,000 customers for the amount of \$6.7 billion. The growth of passive funds popularity will also contribute to the spread of robots-consultants in the coming years: robots usually advise passive portfolios to investors rather than actively managed funds, where the commissions are higher. According to the Morningstar expert assessment, the assets managed by passive funds have increased worldwide by 230% since 2007 and reached \$6 trillion. The same indicator in actively managed funds has risen by approximately 100% to \$24 trillion.

In digital economy the tasks of information support for making managerial decisions are aimed at predicting human behavior. The robots-consultants can evaluate informationally all customer's actions and financial operations: savings, loans, early repayment of a mortgage loan, car purchase, securities trading, etc. On the basis of this analysis the robots-consultants can establish connection between the client's actions and economic situation. Based on the information analysis the computer can predict a model of the client's economic behavior in a particular combination of circumstances.

The number of financial companies using the artificial intelligence technology for financial planning is continuously growing. Applying the information and communication tools and marketing management technologies the consultants aim to identify the signs of customers' dissatisfaction and to determine changes in the life circumstances, which the customers themselves do not mention in conversations with consultants. In modern conditions the opportunities of artificial intelligence application to increase the profitability of customers' investment are tested by large companies, such as Wela, Total Alignment Wealth Advisors and McLean Asset Management. Information and network technologies allow aligning the situation of risk management based on the right selection of managerial decisions.

The PJSC "Sberbank of Russia" announced about its plans to introduce a technology providing the functions of the robot-consultant on legal issues at the beginning of 2017. A robot-consultant is able to issue the customers' statements of case and provide a number of information services. At the same time development of information and network technologies of this format may cause dismissal of about 3 thousand employees of this financial and credit institution. The application of new technologies and tools will allow increasing the level of office work automation and reducing the level of low-skilled specialists. At the end of 2016 the technology was applied in a test mode; a transition of the individuals' statements of case writing function in a digital format has already been done. The bank plans to incorporate the majority of typical legal issues in the system of automated network service in the future.

Implementing the concept of digital office building the PJSC “Sberbank of Russia” started developing the technology of clients’ biometrical authentication in order to increase the information security level. Biometrical technologies have been used in the world for a long time (in criminology, visas and passports issuing); their application in the financial sphere is a promising area, given that we live in the era of smartphones. New technologies introduction will provide regulation of operational risks, as well as contribute to the expansion of the financial institution digital management system. Expansion of the innovative technologies use in the bank’s system of information and network management will allow developing new technical tools providing support for making managerial decisions. Innovative solutions in the sphere of information management in financial and credit institutions will help to adjust the system of the credit institution employees identification based on biometrics. The “Sberbank of Russia” aims to form the base of biometrical data for the identification of employees, operational risks management and development of a scoring system for the borrowers’ risks assessment.

The introduction of the biometrical identification technology in domestic financial and credit system is limited by the factors related to the errors of recognition and changes in biometrical parameters. The complexity of the introduction process lies in the fact that the system of appearance identification of the specialists and clients on biometrical parameters should work 24 hours a day. The effectiveness of the scanning system depends on the level of technologies development. Innovative technologies should block the possibility of customers’ and employees’ opportunistic behavior. A project of identification by voice and appearance (voice recognition and image recognition, respectively) is planned to be also implemented as a result of the information management program introduction at the bank. According to the experts, about 50% of Americans who are the banks customers control their financial operations using the smartphone with biometrics; and in Europe the average indicator of such mobile banking use among mobile phone owners is 41% (Kucher, 2017).

The use of new technologies of information management is actively developing in a number of major Russian banks, e.g. Alfa-Bank, Binbank, VTB, as well as in large insurance companies. As to the identification of customers the financial institutions do it based on the passport or the bank card with PIN-code, but in future the banks plan to apply new methods for customers’ and contractors’ identification.

In September 2016 the Sberbank entered into the Hyperledger, an international blockchain consortium, which represents a digital platform based on the blockchain technology and distributed registries. The blockchain consortium was created by the non-profit Linux Foundation Partnership in December 2015 in order to promote cross-sector blockchain technologies to the market. According to the project founders, the results of this work can change the way of business transactions. The Hyperledger project involves global operators of the world financial market (CME,

Deutsche Boerse, London Stock Exchange), leading information and technology companies (IBM, CISCO, Intel), large financial institutions (ABN Amro, Australia and New Zealand Banking Group, BNP Paribas, BNY Mellon, Moscow Stock Exchange, Wells Fargo, SWIFT), and others.

The Bank of Russia shows an interest in the application of blockchain to record all transactions in the financial and credit market. In order to assess the advantages and disadvantages of this technology the macroregulator formed a working group which designed a model of a message transfer system based on blockchain technology ensuring the data storage and processing in the chain of blocks. A special feature of this management model is the decentralization of records. All transactions are fixed on different computers and verified by the network members. The need to test blockchain and big data technologies is related to the fact that their application creates risks that must be controlled. In this regard large domestic banks and Internet companies are engaged in development of a new model of technological solutions implementation in the financial market. Earlier the megaregulator (2014) outlined negative attitude towards blockchain technology, as it is this basis that numerous cryptocurrencies work on; the most common of these currencies is bitcoin, which the Bank of Russia refers to the “quasi-money” (Mesropyan, 2016).

In the near future a contactless Android Pay technology, analogue of Apple Pay, will start functioning on all smartphones with the same-name operating system in the Russian market of financial services. This means that all smartphones with NFC chips based on the Android system will serve as proper payment tool in the domestic market corresponding to the information security requirements. Managers of commercial banks consider the NFC technology (Near Field Communication) very promising especially in combination with the Android operating system, which dominates in the market today. The essence of innovative NFC technology lies in the fact that it turns the mobile phone into a virtual bank card. To pay for the purchase the smartphone shall be put on the terminal and the amount of the purchase is deducted from the customer's bank card.

Payment transactions from the cards with contactless technology Visa PayWave and MasterCard PayPass are carried out in the same way. The smartphones based on the Android operating system, as well as iPhone 6, iPhone 6 Plus, iPhone 7 from Apple based iOS are equipped with NFC chips in Russia. The Apple Pay started functioning in Russia in October 2016. The payment system Samsung Pay has been launched in Russia at the end of September 2016. Now the smartphones Samsung Galaxy S7/edge, Galaxy S6/edge, Galaxy Note5, Galaxy A7 (2016) and Galaxy A5 (2016) support the Samsung Pay; and in 2017 the app Samsung Pay mini for all Samsung models will start functioning.

Cybersecurity experts also note the convenience and protection of contactless payments using a mobile phone; however they also see risks in them. Financial institutions supported new technology considering the dominance of the Android

platform in the Russian market. Android Pay allows paying for the services not only with phones and tablets based on Android, but also with help of watches with NFC on Android Wear 2.0 and higher.

Innovative project for the Russian market of payment for purchases with smartphones based on Android will be implemented in partnership with several banks, including Alfa-bank, Binbank, Raiffeisenbank and Tinkoff-bank. In 2016 the owners of some models of iPhone and Samsung with NFC chips providing payments were the first to receive the opportunity to pay for purchases with a mobile phone. Android Pay will function on all smartphones with the same-name operating system (Samsung, Lenovo, Alcatel, Huawei, Xiaomi, LG and other Chinese models at affordable prices). According to analytical data of the “Euroset” company report, Android devices take the largest market share (87%) in Russia, iOS (10%) is in the second place, and Windows (2%) is in the third place (Mesropyan, 2016).

The Irish company Ornuu and the bank Barclays had the first trading contract in the global market on the basis of the blockchain technology, implementing a letter of credit for \$100 thousand, confirming the export of butter and cheese to Seychelles Trading Company. Innovative technology allowed performing a transaction within few hours, when in practice such contract management requires about 10 days (Alekseevskiy, 2016).

In the Russian market the first contract based on the blockchain was implemented by Alpha-bank (development of the Alpha-bank Electronic Business Innovation Center) and the S7 Airlines company, the most technologically advanced airline company in the Russian market of air transportation. The Alfa-bank provided the partner with additional technical support based on a network system of electronic interaction “Alpha-business online”. A special feature of the deal is simultaneous use of two smart-contracts, when one contract was used only to open the letter of credit, and the second one was used to close it. The use of two interconnected smart-contracts ensured the decrease of the risks of errors in the code, which increased the transaction transparency. Financial resources were withdrawn from the customer’s account to a special coverage account at the moment of filing an application for a letter of credit, and after submission of the documents the funds were transferred to the contractor’s account.

All transactions for the letter of credit opening and execution were ensured by smart-contracts in the Ethereum system and fixed in the blockchain system. As a result of the operation a cryptographic transformation of the following information occurred: the deal identifiers (individual tax number of the client and the contractor, type of works), as well as its commercial conditions (the letter of credit amount, date of its opening and closing). In terms of law the operation corresponded to all the requirements for the execution of the letter of credit, and tested the possibility of using smart-contracts under the Russian law, experts believe.

The blockchain technology, which was associated earlier with rather ambiguous cryptocurrency bitcoin, is becoming more respectable. The introduction of the blockchain digital technology in different spheres of economy and business activity (e.g., the property rights registration) can cause an “economic revolution” in developing countries, Richard Branson supposes (Branson, 2016). The operation based on the blockchain revealed the effectiveness of smart-contracts for the implementation of business process optimization tasks. Fixing the contract in a distributed registry ensured strict fulfillment of the conditions in financial transactions between clients. The blockchain technology has increased the transaction speed and financial flows transparency.

## **Conclusion**

Based on the blockchain technologies testing in Russia the following can be stated:

- The blockchain technology is becoming attractive in the operation of innovative companies and commercial banks in Russian jurisdiction because it ensures competitive power of financial contracts;
- Growth in the number of economic agents applying the blockchain technology will reduce costs of financial interaction of companies and commercial banks, as well as operational risks by ensuring the contracts information transparency;
- In the financial companies’ cost management system the blockchain technology is rather promising due to ensuring reduction of expenses on back-office, depositary services, specialists’ payroll;
- The blockchain technology application ensures financial security of operations as constantly updated copies of the transactions are stored simultaneously on many computers, and it is impossible to change “quietly” the last entry on one of them; most of other participants of the system will refuse to confirm the entry and the blockchain will remain unchanged;
- In the business processes modernization system the blockchain technology is the most promising as it provides information control over the work of specialists and highly organized centralized structures;
- The blockchain technology use allows making new contracts (agreements for the supply of goods and services, debt obligations, futures, etc.); fulfillment of these transactions’ conditions is guaranteed not by the third party, but by the program code and miners;
- The Ethereum platform, having the status of non-profit fund, allows making innovative contracts, blockchain applications, produce “ether” cryptocurrency; that provides coverage of miners’ costs for the facilities provision.

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